JOURNAL
OF THE
Elisha Mitchell Scientific Society
JUNE, 1910
VOL. XXVI NO. 2

Proceedings of the North Carolina Academy of Science.

The North Carolina Academy of Science held its ninth annual meeting at Wake Forest College, Wake Forest, N. C., on Friday and Saturday, April 29 and 30, 1910.

The Executive Committee met at 3:50 P. M., there being present President W. C. Coker and Secretary E. W. Gudger, *ex officio,* and C. W. Edwards. The Secretary-Treasurer made his report, which was favorably recommended to the Academy in the following items.

The following applicants for membership in the Academy were elected: T. W. Addicks, Assistant Curator State Museum, Raleigh; W. M. Allen, State Food Chemist, Raleigh; Bronson Barlow, State Botanist, Raleigh; Julian Blanchard, Professor of Engineering, Trinity College, Durham; Donald Boyer, Instructor in Sciences, High School, Kinston; S. C. Bruner, student A. & M. College, West Raleigh; R. W. Collett, Supt. State Experimental Farms, Swannanoa; Eva L. Culbreth, Assistant in Mathematics, State Normal College, Greensboro; P. W. Daggett, Associate Professor of Physics, University of N. C., Chapel Hill; L. A. Denson, Section Director Weather Bureau, Raleigh; John W. Ferrell, Assistant Secretary for Hookworm, State Board of Health, Raleigh; R. L. Flowers, Professor of Mathematics, Trinity College, Durham; W. H. Fry, Instructor in Geology, University of N. C., Chapel Hill; P. L. Gainey, Assistant Bacteriologist, A. & M. College, West Raleigh; Anna M. Gove, Physician to State Normal College, Greensboro; W. C. A. Hammel, Professor of Physics, State Normal College, Greensboro; B. B. Higgins, West Raleigh; Hampden Hill, Instructor in Chemistry, University of N. C., Chapel Hill; J. C.

Hines, Jr., Instructor in Mathematics, University of N. C., Chapel Hill; J. S. Holmes, Forester State Geological and Economic Survey, Chapel Hill; A. Wilson Hobbs, Assistant in Mathematics, Guilford College; Mrs. W. N. Hutt, Chairman Woman's Branch Farmers' Institutes of N. C., Raleigh; J. D. Ives, Assistant in Biology, Wake Forest College; C. A. Julian, Assistant Secretary for Tuberculosis, State Board of Health, Thomasville; Rev. Geo. Wm. Lay, Rector St. Mary's School, Raleigh; I. F. Lewis, Professor of Biology, Randolph-Macon College, Ashland, Va.; L. B. Lockhart, State Oil Chemist, Raleigh; Alma J. Long, Professor of Domestic Art, State Normal College, Greensboro; Jno. W. MacConnell, Professor of Biology, Davidson College; C. B. Markham, Assistant Professor of Mathematics, Trinity College, Durham; Gertrude W. Mendenhall, Professor of Mathematics, State Normal College, Greensboro; Mrs. Z. P. Metcalf, Raleigh; C. L. Newman, Professor of Agriculture, A. & M. College, West Raleigh; Nettie L. Parker, Assistant in Mathematics, State Normal College, Greensboro; A. H. Patterson, Professor of Physics, University of N. C., Chapel Hill; Mary M. Petty, Professor of Chemistry, State Normal College, Greensboro; John B. Powers, Professor of Bacteriology and Pathology, Wake Forest College; Mary Robinson, Assistant in Biology, State Normal College, Greensboro; F. W. Sherwood, Assistant Chemist, N. C. Agricultural Experiment Sta., West Raleigh; C. A. Sprague, Instructor in Physics, A. & M. College, West Raleigh; C. W. Stiles, Scientific Secretary Rockefeller Sanitary Commission, Washington, D. C.; Cora L. Strong, Associate Professor of Mathematics, State Normal College, Greensboro; Opal I. Tillman, Scientific Assistant, Bureau Plant Industry, Washington, D. C.; L. F. Williams, Assistant Professor of Chemistry, A. & M. College, West Raleigh; E. L. Worthen, State Soil Expert, Raleigh; E. P. Wood, Assistant State Veterinarian, Raleigh.

The following amendments to the Constitution proposed by the Secretary, were endorsed for favorable action by the Academy. In Art. II., Sec. 1, as amended May 1, 1910, strike out the words "dues for the current year" and insert "initiation

fee." In Art. II., Sec. 2, before the words "The annual dues" insert this sentence, "The initiation fee shall be two dollars, payable in advance, and there shall be no annual dues for the first year."

The Committee requested the Secretary to explain to the Academy that his action in deferring the printing of the Constitution and list of members until autumn, 1910, in order to include the new amendments and the enlarged list of members, had been authorized by it in March, 1910.

It was moved and carried that hereafter, in order to give time for discussion, all papers be limited to 15 minutes unless longer time has been allotted by previous permission of the Executive Committee; that as far as possible, papers be placed on the program as their authors wish, provided, however, that all members have an opportunity to present one paper before any member gives a second; that a paper not read when called for shall go to the foot of the list.

At 4:15 P. M. the Academy was called to order, President W. C. Coker in the chair. The following committees were appointed: To audit Treasurer's accounts, W. A. Withers, Franklin Sherman, Jr., J. J. Wolfe; to nominate officers for the ensuing year, W. L. Poteat, G. W. Lay, Collier Cobb; on resolutions, J. G. Hall, Franklin Sherman, Jr., Z. P. Metcalf.

The balance of the afternoon was spent in reading and discussing papers.

At 8:30 P. M. the Academy reassembled in Wingate Memorial Hall, and was cordially welcomed to Wake Forest College by President W. L. Poteat. President W. C. Coker, of the Academy, fittingly responded and then gave the presidential address, "Science Teaching in the Schools and Colleges of North Carolina."

Because of their general interest, the following papers were presented at this evening meeting, which was largely attended by the college people: "Pellagra: A Preliminary Report," by J. J. Wolfe (with lantern slides); "Halley's Comet," by A. H. Patterson (illustrated with lantern slides); "The Comet: What Is It?" by John F. Lanneau (illustrated by chart).

At 8:45 A. M. Saturday, the Academy reassembled for the annual business meeting. The minutes of last meeting were read and approved. The recommendations of the Executive Committee, as itemized above, were unanimously endorsed. The names of the new members were read. The amendments as proposed were carried. The recommendations about papers on program were agreed to without dissent. On motion, the Secretary was authorized to print the revised Constitution and mail a copy to each member, securing a sufficient number of extra copies to supply future demands.

The Auditing Committee reported that the Treasurer's accounts were found to be correct, there being an available balance of $167.29 less $50.00 due for publishing the proceedings for 1909.

The Nominating Committee brought in the following nominations: President, W. H. Pegram, Professor of Chemistry, Trinity College, Durham; Vice-President, W. S. Rankin, Secretary State Board of Health, Raleigh; Secretary-Treasurer, E. W. Gudger, Professor of Biology, State Normal College, Greensboro;

Executive Committee: F. L. Stevens, Professor of Biology, A. & M. College, West Raleigh; H. H. Brimley, Curator State Museum, Raleigh; H. V. Wilson, Professor of Zoölogy, University of N. C., Chapel Hill.

In the absence of the Chairman, Prof. C. W. Edwards, President Coker reported progress for the Committee on Science Teaching in North Carolina High Schools and Colleges, saying that they had found it impossible to collect and digest the data in time to report at this meeting.

On motion the following committee was appointed to collect data and plan courses of study in the sciences for the high schools of the State, to be submitted for approval by the Academy at the next annual meeting: W. C. Coker, University of North Carolina; C. W. Edwards, Trinity College; G. W. Lay, St. Mary's School; Donald Boyer, Kinston High School; H. V. Wilson, University of North Carolina; F. L. Stevens, A. & M. College; Collier Cobb, University of North Carolina; J. E.

Mills, University of North Carolina; E. W. Gudger, State Normal College.

The business meeting being over, the reading of papers was resumed, and with a short interruption for lunch was concluded at 3:00 P. M. The Committee on Resolutions brought in the following report:

Resolved, That we, the North Carolina Academy of Science, hereby extend our sincere thanks to Wake Forest College for kindness in supplying for us a place of meeting, and for other favors, and

Resolved, That we wish to express our especial appreciation of the kindness of the members of the faculty and their families and others who have so courteously entertained us, and

Resolved, That we wish to express our gratification for the activity of our Secretary-Treasurer in the zealous discharge of his duties.

The following members were in attendance: T. W. Addicks, W. M. Allen, B. Barlow, J. Blanchard, J. G. Boomhour, W. G. Chrisman, S. C. Clapp, Collier Cobb, W. C. Coker, C. W. Edwards, P. L. Gainey, E. W. Gudger, J. G. Hall, B. B. Higgins, W. N. Hutt, J. D. Ives, J. F. Lanneau, G. W. Lay, C. B. Markham, Mrs. Z. P. Metcalf, A. H. Patterson, W. L. Poteat, J. B. Powers, F. Sherman, Jr., F. W. Sherwood, R. I. Smith, F. L. Stevens, Opal I. Tillman, W. A. Withers, J. J. Wolfe.

This meeting equalled any other in number of papers, and excelled any in attendance, in discussion of papers, and in general interest. The number of new members received is 46, of old members enrolled, 43; total, 89.

Adjourned, 3 P. M.

The following papers were presented:

The Cause of Pellagra—A Preliminary Report, Jas. J. Wolfe, Trinity College, Durham.

Believing that Pellagra must be an infectious disease, and that, because of its generalized nature, the organism was most likely to occur in the blood, the writer last September began a

study of some specimens of pellagrous blood, with the hope of throwing some light on the etiology of this disease.

The usual smear preparation was made, stained with methelene blue and studied under a Zeiss apochromat. Bacteria were seen in considerable numbers in most cases (especially severe ones)—milder cases were more difficult and not as yet entirely convincing. These are polymorphic, but generally spherical; grouped often in doubles like a dumb-bell, or irregular clumps; sometimes in chains, and usually between ½ and 1 micron in diameter.

A culture derived from damaged corn shows an organism quite similar in grouping, size, color, reactions and polymorism. This is now being tested with animals.

Peculiarities in the Distribution of Some North Carolina Birds, Franklin Sherman, Jr., State Entomologist, Raleigh.

[This paper appears in full in the current number of this journal.]

The Comet: What is It? John F. Lanneau, Wake Forest College.

The Resin of Pinus Sabiniana, Charles H. Herty and E. S. Tillett, University of North Carolina, Chapel Hill.

[Read by title.]

Medical Entomology, Z. P. Metcalf, Department of Agriculture, Raleigh.

A short popular account of some of the more recent developments in the science of Medical Entomology, which was defined as that branch of Entomology which treats of the relation of insects and insect-like animals in the transfer of diseases from man to man, man to animal, and animal to animal.

This relation was declared to be twofold. In the first case the insect is a necessary intermediate host, and in the second case the insect is merely an incidental or accidental factor in the transfer of the disease. The work of the Board of Health of the city of Asheville was cited as an example of applied Medical Entomology.

The Ammoniafying of North Carolina Soils, F. L. Stevens and W. A. Withers, assisted by P. L. Gainey and F. W. Sherwood, N. C. Agricultural Experiment Station, West Raleigh.

Remarks on the Relation of Our Birds to The Farm and Garden, C. S. Brimley, Raleigh. Read by F. Sherman, Jr.

[Published in full in the current number of this journal.]

Where to Find Amebas, E. W. Gudger, State Normal College, Greensboro.

The directions given in the books are very indefinite, as the writer found to his sorrow in his early biological days. Acting on a suggestion made by Dr. D. H. Tennent, now of Bryn Mawr College, he at that time successfully sought them in the yellowish-green diatom deposits on the bottom of stagnant ditches or of quiet pools in brooks. In seven years these have never failed to furnish abundant material. The writer's classes are supplied from a tiled drain at the foot of a bank less than 100 yards from the laboratory. These amebas vary in size from quite small to those so large that they cannot be seen in their entirety under the ordinary high objective.

The Origin of Thermal Waters, with Special Reference to Hot Springs, Ark., Collier Cobb, University of N. C., Chapel Hill.

Some Aids to Better Work in Science, C. W. Edwards, Trinity College, Durham.

[Read by title.]

A New Hybrid Habenaria of North Carolina, J. G. Hall, N. C. Agricultural Experiment Station, West Raleigh.

A hybrid Habenaria was reported from the neighborhood of Kinston, N. C. This natural hybrid seemed to be pretty well intermediate between the two supposed parents, H. ciliaris and H. blephariglottis. Photographs of the flowers were shown and these presented some characters of the parents and the hybrid.

The Present Status of the Darwinian Hypothesis, W. L. Poteat, Wake Forest College.

Some Experiments on Ionization by Impact: The Time Variation of the Current through a Gas Ionized by Radium, J. Blanchard, Trinity College, Durham.

The ionization vessel was a glass tube with parallel plate electrodes about 5 centimeters in diameter, both plates coated (though unequally) with a thin layer of a very impure salt of radium. With the plates about 1 centimeter apart and the pressure about 1 millimeter, with a potential difference sufficient to produce considerable ionization by impact, it was found that the current decreased with the time the battery key remained closed, reaching its minimum value in about an hour. On opening the key the initial conductivity was almost totally regained in about the same time. Upon reversing the potential at the end of an hour the current was sometimes found to be greater than it was initially in this reverse direction, but also decreasing with the time as before.

The potential difference apparently causes an increased amount of ionization near the positive plate, the effect being detected only when the potential gradient is sufficient to cause ionization by impact. Further experiments are in progress.

Is the Fusarium Which Causes Cowpea Wilt Genetically Connected with Neocosmospora? B. B. Higgins, N. C. Agricultural Experiment Station, West Raleigh.

In 1889 the wilt disease of cotton was studied by Prof. Geo. F. Atkinson, and its causal fungus named *Fusarium vasinfectum.* A few years later (1894-99) the wilt disease of cotton, watermelon, and cowpea was studied by Erwin F. Smith. He found no specific differences between the fungi upon any of the three hosts. He found, however, upon some of the plants previously killed by the wilt fungus an acigerous fungus which he considered the perfect stage of *Fusarium vasinfectum.* The fungus was therefore renamed by him *Neocosmospora vasinfecta,* and this conclusion has been accepted by subsequent writers. The evidence upon which this conclusion was based was very weak, however; and a recent study of the two forms by the writer—the results of which will at an early date be pub-

lished in bulletin form—has caused the writer to reopen this question, which was considered closed.

Some Experiments in the Propagation of the Diamond-Back Terrapin, Henry D. Aller, Director Laboratory of Fisheries, Beaufort.

Read by the Secretary.

[This paper appears in full in the current number of this journal.]

The Present Status of the Relativity Problem, C. W. Edwards, Trinity College, Durham.

[Read by title.]

The Locus of a Moving Point When the Sum of Its Distances From Two Fixed Points, Their Difference, Their Product, or Their Quotient, is Constant, John F. Lanneau, Wake Forest College.

The loci determined by the first three conditions are the well known Ellipse, Hyperbola, and Lemniscate.

Under the fourth condition: Take line through the fixed points F and F' as x-axis; the point O, midway between them, as origin; 2c for distance F to F'; K for the constant quotient when the moving point is on one side of the y-axis, and therefore $\frac{1}{k}$ the quotient when it has the corresponding position on the other side.

1. The equation of the locus is $x^2 + y^2 - 2c\frac{k^2+1}{k^2-1}x + c^2 = 0$

The locus, therefore, consists of two equal circles whose centers are on the x-axis beyond F and F' at equal distances from O.

2. A discussion of the equation shows:

If k=1, the circles are of infinite radius, and are tangent at O;
If k is either O or OO, the circles reduce to the points F and F';
If k has, in turn, any series of values between 1 and O, or between 1 and OO, the loci form a group of circles about F and a similar group about F'—the number of circles in each group limited only by the number of values given to k.

3. None of the circles of the F and F' groups pass through either of the fixed points F and F'.

Any circles drawn through F and F' are extraneous to the loci, but each such circle is orthogonal to every circle in the loci groups.

Notes on Fungi, F. L. Stevens and J. G. Hall, N. C. Agricultural Experiment Station, West Raleigh.

Three new species of Claviceps were described. Two of them are upon Paspalum and are thought to be the perfect stages of the fungus usually known as *Schlerotium Paspali S.* Germination of the sclerotium was described and the characters of the fungus were illustrated by photographs and specimens. The third species grows upon Gama grass (*Tripsacum dactyloides L.*) Both sphacelia and ascosporic stages were exhibited. Technical descriptions were given under the names *Claviceps Paspali* (S.) n. comb.; *C. Rolfsii* n. sp.; and *C. Tripsaci* n. sp. These will be published in full elsewhere, soon.

Specimens of a Cercospora upon persimmon, which was thought to be new, were also shown.

Some Methods of Making Illustrations, Z. P. Metcalf, Department of Agriculture, Raleigh.

A brief consideration of the more important methods of making illustrations. Drawings with their reproductions were shown covering the following methods: pen and ink, pencil and crayon, watercolor, oil color, photographs, lantern slides and color photography.

Precautions Necessary in Estimating Climates of Geological Time, Collier Cobb, University of N. C., Chapel Hill.

The Jaws of the Spotted Sting Ray, Aetobatus Narinari, E. W. Gudger, State Normal College, Greensboro.

This ray was discovered in Brazilian waters, described and figured by George Maregrave sometime between the years 1637 and 1644. His description of fish and jaws was published in 1648. This pavement-toothed ray has but one set of teeth—

the central one—in each jaw, the lateral teeth found in the others of its kind having all disappeared. In the upper jaw are found 14 I-shaped teeth, in the lower 17 broad V-shaped grinders as noted by Marcgrave. The lower jaw is the longer and projects beyond the lips. With it and the fairly long snout, the ray digs up the clams on which it feeds.

The paper was illustrated by photographs of dorsal, ventral, and lateral views of the ray, and by a pair of dried jaws.

The writer has in preparation for the U. S. Bureau of Fisheries a paper in which he hopes to bring together all the work ever done on this fish, and in which will be included his observations and the photographs above mentioned.

The Cocoanut Crab, John F. Lanneau, Wake Forest College.

Called also the Robber Crab and the Pouch Crab. Shaped more like a lobster than a crab. Found on islands of the South Pacific. Weight usually 5 or 6 pounds, sometimes 20.

Feeds on fallen cocoanuts. Said to climb the trees. Is highly esteemed as food, especially the rich fatty content of the pouch.

Is found on our island of Guam. It and other singular forms of life on that pleasant little island would repay a biologist's investigation. His visit would likely be facilitated by our Secretary of War or Secretary of Navy.

A Double Flowering Dogwood, F. L. Stevens and J. G. Hall, N. C. Agricultural Experiment Station, West Raleigh.

A case of "double-flower" of the common Flowering Dogwood (*Cornus florida L.*) due to the excessive development of the small bracts that subtend the individual flowers of the ordinary head, was reported. There was, as well, the suppression of all the individual flowers except the central one, which appeared entirely normal.

A Note on the Development of the Gall-Fly Diastrophus Nebulosus, O. S., J. D. Ives, Wake Forest College.

[This paper is published in full in this issue.]

Pecan Culture in North Carolina, W. N. Hutt, State Horticulturist, Raleigh.

E. W. GUDGER, *Secretary.*

SUMMARY OF RECENT EXPERIMENTS ON THE CULTURE OF THE DIAMOND-BACK TERRAPIN AT THE FISHERIES LABORATORY, BEAUFORT, N. C.

By Henry D. Aller,
Director Beaufort Laboratory.

It having been determined by the Bureau of Fisheries to resume experimental work looking toward the culture of the diamond-back terrapin at the Beaufort, N. C., laboratory, the construction of a large concrete pound was begun at that place late in the year of 1908. The concrete work consisted of one side wall, 45½ feet long, running parallel to the shore, and two end walls, each 28½ feet long, running at right angles to the other wall. Plank extensions inshore gave a rectangular pound 45½ feet by 44½ feet. The location of the pound was such that during a portion of each tide a part of the interior was flooded with salt water. An opening about three feet wide in the offshore wall, crossed by gratings to prevent the escape of terrapins, permitted the tide to rise and fall freely within the pound. With ordinary tides a considerable part of the interior of the pound was above high water level.

The stock of terrapins consisted of about a dozen which had been kept at the laboratory for a number of years, being a part of those used for experimental work at Beaufort, twenty purchased from a firm at Crisfield, Md., and a number secured from local sources. In all between sixty and seventy were available for the work, in the proportion of about two females to one male. They were placed in the pound in the spring or early in the summer of 1909. They were fed abundantly, mostly on crabs and fresh fish. During the season there was no evidence of any egg-laying. During December, 1909, while excavating a quantity of earth from the pound, a number of young diamond-backs were unexpectedly discovered. Twelve in all were found. Eleven were in good condition, the twelfth having been injured in the excavation work. They were of uniform size, measuring

from 25 to 28 millimeters in length, the lengths being taken along the median line of the plastron. The young were buried in sand in various places, some in the laboratory and others out of doors. No special care was given them, aside from keeping the sand containing those in the laboratory moist and in protecting all from freezing. No food was given them. They remained buried until about the first or second week in April, when they began to come to the surface, as if preparing for an active existence.

The chief conclusions are: first, that diamond-back terrapins will breed in captivity with little attention, provided they have plenty of food and free access to water; second, the young may be easily cared for during the early part of their life. Apparently all the young were hatched from eggs laid in ground which had received no attention. So far as is known, none were hatched in the sand-beds prepared for nests. It is not necessary, and perhaps not possible to supply the young with food prior to the spring following the year during which they were hatched.

During June, 1909, a number of eggs were collected from nests made under natural conditions in the vicinity of Beaufort. These eggs were buried in sand at the laboratory, but the attempt to hatch them was not successful. Whether the failure was due to improper handling of the eggs cannot be said, but it is doubtful whether this method of raising terrapins would ever be of any economic value.

The work has been carried on under the general direction of Prof. W. P. Hay, of Washington, D. C.

REMARKS ON THE RELATION OF BIRDS TO OUR FARMS AND GARDENS.

By C. S. Brimley.

This paper is prompted by a letter that appeared some time ago in the Progressive Farmer, in which the writer stated that he wished there were one thousand beneficial birds to every one we now have, and in which he advocated the stopping of all hunting and shooting as a means to secure that desired end, evidently thinking that if birds were only let alone they would increase indefinitely, which of course is not the case. This leads me to ask the question,—Why are not birds more numerous in our farms and gardens, and why do they not eat up more of the insect pests that destroy our crops? A good many persons would answer that there were not enough of them, and would say that the scarcity was caused by the recent wholesale destruction of them for millinery purposes, being unaware that practically all the birds killed for that purpose of late years have been shore and sea birds which would only occur on cultivated land under exceptional circumstances.

Now there is undoubtedly rather a scarcity of birds on the average southern farm, and what we want to do is to find out the reason for it, and see if a change cannot be brought about.

If then we consider the natural habits of our small land birds, what do we find? Just this, that a very large majority of them are naturally woodland birds, and what may I ask is there in acre after acre of such clean culture crops as corn, cotton or tobacco, to attract any forest loving species at all? Frequently too we find the farm house standing unshaded with no trees around it, often there is no orchard, and the only birds that will frequent such a farm are those that can find patches of briars or bushes to build their nests in. Mind you I am not saying there may not be plenty of birds in the adjacent woods, but they would feed and breed in the woods, and would hardly be seen on the farm at all.

What is the remedy for this? Let the farmer plant some shade trees, and an orchard, and when the trees get big enough

he will find birds will come and nest in them, and vice versa, if he cuts his trees down the birds will leave also. I can give an actual instance of the latter fact. There used to be a little way from Raleigh, a large mulberry orchard, in which orioles, tanagers, yellow warblers, catbirds, cardinals, kingbirds and others dwelt in numbers during the summers, in fact there were more individual birds there than in almost any place I ever saw. Now, however, that orchard has been entirely cut down, and with the disappearance of the trees the birds have also disappeared.

Then again if he has a real pasture, not merely a fenced-in piece of swamp or pine woods, he will find a few kinds will sooner or later be attracted to it and will nest there. Mind you I am not saying that we can get enough birds on any farm to be a substitute for paris green or arsenate of lead as a remedy against injurious insects; in fact I am inclined to look upon that as an iridescent dream, but still by paying some attention to the needs of the birds we can get quite a number of kinds to make their homes near our homes, and that without doing anything that we ought not to do anyhow.

To take a concrete instance, I moved to my present residence, some ten years ago, and at that time there were a lot of big trees around the house, but nothing else. Since then, however, I have planted a lot of bushes,and some fruit trees, so that there is a great deal more growth on the lot than there was when I came there, and there are also a good many more birds there both winter and summer than at first.

Now, what are the birds that will be attracted by such measures to the neighborhood of our dwellings, and of course the answer is only those that are able to adapt themselves to the changed conditions brought about by man. The species that will come around in *summer* under such conditions are the robin, the bluebird (if there is a suitable hole or two for him to nest in), the purple martin (if we hang up martin gourds), the summer tanager, yellow warbler, red-eyed and yellow-throated vireos, crested flycatcher—also dependent on a nice hole for a nesting site, wood pewee, catbird, mockingbird, caro-

lina wren, (he is likely to come anyway) red-headed woodpecker (if there are oaks to furnish him acorns) field sparrow, chipping sparrow, English sparrow and others that I do not call to mind at present.

Sad to say, however, most of these birds, all of which, except the martin, nest more or less on my lot, stay up in their trees, and do not come into my garden at all, the exceptions being the three kinds of sparrows mentioned, the catbird, carolina wren, with an occasional summer tanager and wood pewee. The two vireos never come there. This brings me to another phase of the subject, which is that do what we will, we are not going to get birds that are naturally arboreal to come down out of their trees and feed on the ground, however much we may want them to do so—and hence I believe that our birds must inevitably be of much greater importance to the forester than to the farmer. Some of the species mentioned above, however, may be economically useful, and these are the two native sparrows and the catbird.

Passing now to our *winter* birds, we find these largely frequent clumps of bushes and thickets, while other species are found in open fields, and many of these latter undoubtedly are beneficial on account of the cutworms, white grubs, and other insects they destroy, the meadowlark and titlark being familiar examples of such open field birds. Those species that inhabit thickets, both great and small, undoubtedly also destroy large numbers of hibernating insects that would otherwise come out next spring to do damage, and which pass the winter in the shelter of such places. In fact, offhand it looks as if the winter birds might do more good than the summer species.

The principal winter birds that frequent thickets or clumps of bushes in and around fields are the song, white-throated, and field sparrows and the slate-colored junco (snowbird), all of which, especially the first two, are common in my garden.

DEVELOPMENT OF SPONGES FROM TISSUE CELLS OUTSIDE THE BODY OF THE PARENT*.

By H. V. Wilson.

About five years ago I suggested to the Bureau of Fisheries that an investigation to cover the various ways in which sponges reproduce might yield some results of value for scientific sponge culture. I had in mind the high degree of reproductive (technically, regenerative) power possessed by at least certain body cells, as distinguished from germ cells, in sponges.

This great regenerative power of somatic cells in sponges is displayed, as has long been known, in the formation of asexual masses which under proper conditions develop into new sponges. The regenerative masses of this kind that are best known are the gemmules of fresh-water sponges, but similar gemmules have been discovered by Topsent and others in marine sponges. Observations of my own, dating as far back as 1889,† indicated that in some marine sponges such asexual masses not only possess the power to transform into sponges, but in so doing pass through a swimming stage not distinguishable from the ciliated larva which typically develops from an egg. In a case of this kind, as I have pointed out (op. cit., 1891), the nature of the body cell as measured by its potentialities is fundamentally like that of a germ cell—it has full regenerative power, including the ability to recapitulate in some measure the ancestral history of the protoplasm. Considerations of this kind led me to doubt whether in all metazoa the protoplasm really did divide sharply into somatic and germinal cells. Rather was the idea encouraged that in the lower metazoa, such as sponges, the cellular elements all retained just so much of the nature of the germ cell (just so much of the specific idioplasm, one might say) as would enable them, under the influence of an appropriate stimu-

*Reprinted from Bulletin of the Bureau of Fisheries, Vol. xxviii, p. 1265-1271, May 1910.

†Wilson, H. V.: Notes on the development of some sponges. Journal of Morphology, 1891; Observations on the gemmule and egg development of marine sponges, ibid., 1894.

lus, to develop either into ova or sperms, or into asexual reproductive masses. Assuming that sponge protoplasm had this eminently plastic character, I conceived that one might discover ways in which to call into unusual activity the reproductive or regenerative power, and so, as it were, to invent new methods of growing sponges.

The results, at this time, of the investigation that I have been conducting for the Bureau during the past five summers at the Beaufort laboratory justify, it seems to me, the point of view above outlined. Two new methods by which sponges may be grown have been discovered, and both of these methods attest the remarkable regenerative power of the body cells of sponges. That both methods are applicable to the commercial sponge there can hardly be a doubt. Whether at the present time any economic advantage would accrue from the practice of either is perhaps doubtful, in view of the fact that sponges may so successfully be grown from cuttings—a method first practiced by Oscar Schmidt, and further developed in this country by Richard Rathbun, while in recent years H. F. Moore has brought it through a long series of admirable experiments to a high degree of efficiency.

But while the methods which I shall presently describe may not now be of practical utility, they add something to our knowledge of the underlying scientific principles of sponge culture. And it is a truism that such principles are the funds, so to speak, on which the practice of succeeding generations draws in the conduct of economic enterprises. I am convinced that our knowledge of these scientific principles of sponge culture may be vastly increased. Future researches will surely clear up, among other points, the relation between the formation of sexual products (ova and sperms), of asexual masses which transform directly without passing through the swimming stage (ciliated larva), and of asexual masses which imitate the egg development in passing through the stage of the ciliated larva. I may add that such a relation is "cleared up" to the eye of science (in contradistinction to metaphysics) only after the discovery of the actual treatment to which, when the sponge tissue is sub-

jected, it responds by the development of this or that reproductive body. In this instance, as in many such biological problems, the most intimate knowledge of the structure and movements of the cells concerned in the production of each kind of body is necessary. But such knowledge of itself falls short, and remains unsatisfactory until it leads up through experiment to an actual control of the phenomena—to the power which can at will compel the sponge to produce the one or the other kind of reproductive body.

The first of the two new methods to which I have alluded has been described in Science.* It is briefly as follows:

If sponges are kept under appropriate conditions in aquaria, the body dies in some regions, but in localities the cells remain alive and congregate to form masses. In the production of such masses the component cells lose their individuality, fusing with one another to form a continuous mass of protoplasm studded with nuclei (a syncytium). Such masses of syncytial protoplasm are easily seen with the unaided eye scattered through the interior or over the surface of the remains of the original sponge. They are frequently spheroidal, but often of an irregular shape, and have the power of slow amœboid movement. In successful cases of treatment these masses, varying from a fraction of a millimeter to a few millimeters in diameter, are exceedingly abundant. The smaller ones of more regular shape at once call to mind the gemmules that are normally formed in such sponges as *Spongilla*. Experiment shows them to be physiologically like such gemmules in that they have the power to transform into perfect sponges. To bring about this transformation it was only necessary to remove the regenerative masses to the open water of the harbor at Beaufort, where they were kept in small bolting cloth bags suspended in a floating live box. The sponge

*Wilson, H. V.: A new method by which sponges may be artificially reared. Science, June 7, 1907.

especially worked on was a silicious form, a species of *Stylotella.**

The second of the two methods, a description of which may be found in the Journal of Experimental Zoölogy,† is the more interesting and important. It should be said that the method succeeds best with sponges in which there is a considerable development of horny skeletal fiber. The form especially used in my work has been *Microciona prolifera* Verrill, and it has proved practically necessary to use always the large bushy specimens. The procedure is as follows:

Cut the sponge into small pieces and put them on a square of bolting cloth. Gather the cloth round the sponge fragments in the shape of a bag. Holding the upper end closed with the fingers, compress the bag repeatedly with small dissecting forceps. The bag meantime remains immersed in a little dish of sea water. The sponge cells are squeezed free of the skeleton and are strained through the pores of the bolting cloth. They fall like a fine sediment on the bottom of the dish. Collect the sediment with a small pipette and strew it over glass plates or shells immersed in sea water. The originally separate cells quickly combine with one another, exhibiting amœboid phenomena. The masses so formed go on fusing with one another through the formation of peripheral pseudopodia, and thus the whole surface of the glass slide (or other object used) may become covered with a network of plasmodial masses and cords, which adhere to it with some firmness. After perhaps half an hour the plate should be lifted from the water and cautiously drained. The sponge plasmodia are thus flattened out somewhat and their attachment to the plate is strengthened. Return the plate at once to a dish of fresh sea water, where it should be left with two or three changes of water for a day. By this time the network of plasmodia has probably transformed itself in whole or in great part into a thin uniform incrustation. It is best now to transfer the

*Otto Maas has independently discovered that the cells of calcareous sponges under the influence of reagents exhibit a behavior essentially like that above described. See my account in Science, loc. cit.

†Wilson, H. V.: On some phenomena of coalescence and regeneration in sponges. Journal of Experimental Zoology, vol. v. no. 2, December, 1907.

plate to the open water. My practice has been to tie such plates to the inside of galvanized-wire boxes, and to hang the boxes in a large live-box.

In the course of a week it will be found that the incrustation has transformed itself into a functional sponge with pores, oscula, well-developed canal system, and flagellated chambers. The steps in this gradual differentiation may be followed by examining the sponge at intervals under the microscope. The differentiation goes on, but at a slower rate, in preparations kept continuously in laboratory dishes or aquaria. While the sponge incrustation is quite thin, the currents of water and vibrations of the flagella in the flagellated chambers may be observed with a high power. For this purpose small incrustations grown on cover glasses are the best.

Until the past summer it was a question whether sponges produced in this way would continue to grow and would develop the skeleton characteristic of the species. If they would not, it was clear that the method had no value for economic sponge culture. And so, early in July, I again visited the Beaufort laboratory and with the help of my assistant, Mr. R. R. Bridgers, started some *Microciona* plasmodia on glass slides and oyster shells. It was possible for me to remain at the laboratory only two weeks, but Mr. Bridgers took charge of the sponges and continued to start other plasmodia at intervals during July and August, conducting his experiments with great care and skill.

Mishap of course overtook some of the cultures; but scores of them grew perceptibly during the summer and by the first of September a large number had developed the skeleton of the adult with the characteristic spicules and the horny columns projecting up from the basal skeletal plate. What was equally gratifying was that the sponge in many cases had not only spread and thickened and developed the species-skeleton, but had also developed quantities of reproductive bodies. These lay scattered in the deeper part of the incrustation, plainly visible to the eye. I have not yet made a sufficiently precise histological examination of these bodies to determine whether they are egg larvæ or asexual masses. The whole appearance of the

sponges grown in this way, some six weeks old, is quite like that of normal *Microciona* of incrusting habit.

Looking from the utilitarian standpoint at this latter method of growing sponges, it is not at all inconceivable that it may at some time be of direct economic value. The ease with which quantities of sponge cells may be had and the opportunity afforded of attaching them to any desired object are considerations which encourage such an idea. Going farther afield from present-day practice and looking to the future, the method suggests itself as one of the possible means of altering the specific characteristics of sponges and improving races. In a paper presented to the National Fishery Congress of 1898* I briefly discussed the possibility of improving sponge races, suggesting as means thereto the breeding of sponges from the egg with accompanying selection, and also the practice of grafting. Now if the cells of two closely allied races were mixed together it is on the whole probable that a composite plasmodium would result which would develop the characteristics of both races. Such a form would be something comparable to a hybrid. I have in fact carried on experiments of this character.† The results of my experiments were negative—the cells of each species coalesced, but there was no permanent union between the cells or cell masses of the different species. It should be said, however, that the species used were so unlike that there was at the outset but little chance of coalescence. In a more favorable locality, where a great variety of horny sponges exist, such experiments hold forth some promise.

NOTE.—In connection with the foregoing paper there was an exhibit of microphotographs illustrating some of the more important stages in the development of sponges from cells forcibly removed from the parent body.

*Wilson, H. V.: On the feasibility of raising sponges from the egg. Proceedings of the National Fishery Congress, 1898, in U. S. Fish Commission Bulletin, vol. xvii, 1897.

†Journal of Experimental Zoology, loc. cit.

PECULIARITIES IN THE DISTRIBUTION OF SOME NORTH CAROLINA BIRDS.

By Franklin Sherman, Jr.

In view of the fact that a volume on the birds of North Carolina is already in preparation by Messrs. T. G. Pearson and C. S. Brimley, which will include a few observations made by the writer at various times, it seems desirable to present some of them at this meeting.

A lost or startled bird may wander (or be carried by storm) far out of its natural range. It is not to such accidental circumstances that we wish to refer, but rather to the occurrence of certain birds in nesting season in natural behavior, at localities not generally heretofore known to be within their breeding range.

In the working out of areas of distribution and life-zones, data on the places where a bird nests, are far more valuable than records of its mere occurrence.

song sparrow (*Melospiza fasciata*, Gmel.)

The nesting range of the song sparrow is, in general, northern. Chapman says: "breeds from northern Illinois and Virginia north to Quebec and Manitoba." Curiously enough, all but one of the earliest breeding records for this State were from the coast, indeed, on the very "banks" or fringe of low sandy islands that separate our mainland from the ocean. Mr. Bishop reports that a few breed on Pea Island. Dr. Coues, working chiefly at Fort Macon on the banks at Beaufort, reports that it is a resident (present all the year) though most of them pass north to breed. Mr. Pearson once observed it singing at Cape Hatteras on May 15th. In July, 1906, Mr. Pearson observed it very common at Ocracoke, and he observed it there in other years. These are the eastern records.

The first western North Carolina records are: Three seen frequently in summer of 1892, by Philip Laurent at Cranberry (Mitchell County). Common on Roan Mountain up to 3,500 ft., in June 1895 (S. N. Rhoads). A pair seeen at Asheville July 26, 1902, by T. G. Pearson. Nevertheless, Cairns, who

worked for years around Weaverville, in Buncombe County, makes no mention of it, and Mr. Brewster, who gave some time to ornithological study in Haywood, Jackson and Macon counties in May and June 1885, did not list it at all.

The writer is positive that he saw the song sparrow at Highland (Macon County) in the summer of 1903 or 1904, when he crept close to a singing specimen which was exposed to full front view in the top of a small tree, but the fact was not positively recorded, especially as there still existed some doubt of its being in our mountain section in breeding season. The writer had some discussion with our local ornithologists on the subject, which led to a determination to find out the facts.

During the summer of 1907 the writer spent some days at Hendersonville, where he recorded a number for mid-June—and a little later recorded the species at Highlands again. During the same season Mr. S. C. Bruner both saw and collected specimens at Blowing Rock and recorded it as "common." He also found a nest. Immediately after the meeting of our Academy at Greensboro two years ago, Mr. C. S. Brimley and the writer started on a tour of two weeks through the southwestern counties. The species was recorded at Blantyre (Transylvania County), and Highlands, and was collected at Aquone (Macon County). During the same summer (1908) Mr. R. W. Collett working in the Swannanoa Valley near Black Mountain, reported it "as common as the field sparrow. Have never seen but one breeding pair in Cherokee or Graham counties." He reported seeing birds feeding young. June 18 to 24, 1909, the writer observed it to be common at Linville, Linville Falls, Blowing Rock, Boone, Valle Crucis, and Patterson.

Why the status of this bird as a common breeder throughout all the higher parts of our mountain region should have been so long a matter of speculation, is difficult to explain. We consider it common enough now—why did not Cairns or Brewster record it? Possibly it has not always been a common breeder in these sections.

Yet, all through the piedmont and western part of the coastal plain the song sparrow is present only in winter, and goes north

in spring to breed. That it should breed in this State only along the very verge of the ocean itself and in our higher mountain localities is worthy of mention.

TOWHEE (*Pipilo erythropthalmus,* Linn.)

This bird is a member of the sparrow family, spends much time on the ground, and is a vigorous scratcher, as might be inferred from its large feet. It is the sort of bird that is apt to be well known in localities where it remains for any length of time. Locally it is sometimes called the "Joe-rigger."

For sometime we have known that the towhee breeds in the mountains in the western part of the State, where it is on record from Hendersonville, Blowing Rock, Highlands, and Buncombe County. On June 9, 1909, Mr. C. S. Bruner observed one at Taylorsville, which is on the verge between the mountains and the piedmont, as it is near the Brushy Mountains, an eastern spur of the Blue Ridge. We have also known that it breeds near the coast. Dr. Coues lists it as a common summer resident at Fort Macon. Dr. J. W. P. Smithwick says it is "ordinarily seen in summer in the east." The writer recorded it as common at White Lake in Bladen County May 18 to 22, 1909, and both Mr. C. S. Brimley and the writer have recorded it at Lake Ellis, Craven County, in May and June in several different years. But we have had no clear and definite records of it in breeding season in the piedmont, unless the Taylorsville record could be so considered.

On July 29, 1908 (midst of breeding season) the writer observed both sexes of the Towhee common on a drive between Stony Ridge, in Stokes County and Stoneville in Rockingham County. So it does at least breed in some sections of piedmont North Carolina.

BARN SWALLOW (*Chelidon erythrogaster,* Bodd.)

Until last year breeding records of the barn swallow were confined to extreme eastern North Carolina, although the great bulk go north of this State to breed. Dr. Bishop and Mr. Pearson record nests on Pea Island. Mr. Pearson reports two nests found at Wrightsville in July, 1903, and the same observer reports two birds seen 15 miles north of Southport in June, 1908.

On July, 20, 1909, the writer observed a pair nesting and in perfectly natural behavior in a barn at Valle Crucis, Watauga County. This locality is at an elevation of 2,500 to 2,700 feet. It is *probable* that it breeds in other localities in at least the northern part of our mountain region.

LOGGERHEAD SHRIKE (*Lanius ludovicianus,* Linn.)

This bird has been known to North Carolina ornithologists chiefly as a winter visitor, arriving from the north in fall, and departing to the northward in spring. Winter records are from Raleigh, Durham, Chapel Hill, Greensboro, Warrenton and Red Springs. Breeding has been recorded from the western half of the State, at Morganton and Statesville. Dr. Smithwick does record it as breeding at LaGrange, though more common as a winter bird.

On April 27, 1909, the writer saw a shrike acting very much at home in a yard at Laurinburg, apparently preparing to nest, as it made frequent trips to the tangle of a scuppernong grape arbor. On July 21, 1909, a pair were observed flying along road and perching on telephone wires at Kelford, in Bertie County, and on July 27 (only six days later) a pair, seemingly mates, were seen at Kingsboro, in Edgecombe County. It seems likely, therefore, that the shrike nests (sparingly perhaps) throughout piedmont and eastern North Carolina.

ROBIN (*Merula migratoria,* Linn.)

This bird is well known to all of us. Of its breeding range Chapman says: "Breeds from near the southern border of the United States northward to the Arctic coast." Nevertheless, it has not until recently been known to nest in eastern North Carolina. Dr. Smithwick in August, 1908 wrote: "I have never seen a robin nesting east of Chapel Hill." His observations were mainly from southeastern Bertie, southeastern Beaufort, and Lenoir counties. At Belvidere, Perquimmans County, Mr. Pearson recorded a pair building April 25, 1898, and in late June, 1909, Mr. C. S. Brimley found the species abundant at Southern Pines and they must have been nesting at that date.

On July, 18, 1909, the writer observed several at Gatesville in the tall shade trees—and on July 30, 1909, observed several

in like situation at Grimesland, Pitt County. Several pairs of robins remained in Raleigh through the summer of 1909, and Mr. Brimley has known the species there for many years, in sparing numbers.

From a number of the foregoing records it will be noticed that certain birds, notably song sparow, towhee and barn swallow, are of northern range so far as breeding is concerned, yet they nest along our coast and in the mountains, while all through the central part of the State they are hardly seen at all in breeding season. Yet the mountains, generally speaking, furnish the northern conditions, and the coast furnishes the more southern conditions. Why should a bird of northern tendencies show a preference for the northern and southern extremes of our State and yet seem to shun the great middle ground? It may be noted in this connection that the same peculiarity is shown by certain plants, of which the wild cranberry is an example. This plant grows wild naturally in certain swampy areas in Mitchell County in the west, at altitudes of 3,000 ft. and in the low swamps of Dare and Tyrrell counties in the east, practically at sea-level, yet the plant is not known in all the region between. The same peculiarity has been noted in the distribution of certain mammals.

Mr. W. W. Ashe, who has long studied the plants of the State and their distribution, says that the explanation of these phenomena is that in the coast region the great humidity of the atmosphere reduces the apparent heat to the plant or animal, so that its needs are met as completely as in a more northern latitude.

All of which shows more and more clearly that this State furnishes a fine field for the student of geographical distribution, and the few interesting facts thus far discovered are probably only an indication of many more that are yet hidden.

I am under obligation to Mr. C. S. Brimley for the many records with which mine are here compared. Even my own records were sent direct to Mr. Brimley, who returned them again to me, and at whose suggestion this paper has been prepared.

A NOTE ON THE DEVELOPMENT OF THE GALL-FLY *DIASTROPHUS NEBULOSUS,* O. S.

By J. D. Ives.

The average number of larvæ taken from blackberry knot galls in January was about 85. But in most of the galls there were places where some of the insects had evidently emerged. In one gall there were as many as 39 such places, while in others there were but few; making the average number of larvæ contained in a gall about 100.

In certain of the galls the number of parasitic or inquilinus larvæ, namely those of *Torymus sackeni,* Ashm., and *Eurytoma sp.* exceeded those of *Diastrophus nebulosus,* O. S. The parasitic larvæ being hairy, were quite easily distinguishable from the hairless larvæ of *Diastrophus,* though nearly the same size, each being about 3 mm. long.

The larvæ of *Diastrophus* began to pupate February 26. A day or so before the larvæ pupated their eyes could be seen through the skin. They appeared as light brownish-pink areas on the second somite of larvæ. The color was in fine pigment spots which gradually enlarged and turned darker as the insect matured. At 2 P. M. I observed a larva about to transform; at 5 P. M. the transformation was complete.

The larvæ of *Torymus* and *Eurytoma* pupated March 5th. At 11 A. M. I noted one larva about to transform. By 11:15 the somites were hardly distinguishable. At the posterior extremity there was a protuberance of the old skin. At 11:30 the size of the protuberance of skin had greatly increased and the head and part of the thorax was free. At 12 the thorax and part of the abdomen were free. By 1:30 the process was complete, though the moulted skin clung to the abdomen for several days. Throughout the process the larva was very active, especially its posterior portion.

By March 11 *Diastrophus* transformed into the adult, while the inquilinus insects transformed March 21.

COMPOSITION OF SEA WATERS NEAR BEAUFORT, NORTH CAROLINA.*

By Alvin S. Wheeler.

Clarke in his "Data of Geochemistry" reports no analyses of sea waters along the coasts of North America. Possibly no careful analyses have been made. These analyses were undertaken owing to the increasing interest which biologists are taking in the chemical composition of sea water as a feature of the environment of sea life. The work was done during the summer of 1909 at the U. S. Biological Laboratory at Beaufort, N. C., and for the U. S. Bureau of Fisheries. I wish to express here my thanks to the Commissioner of Fisheries, Mr. George M. Bowers, for his courtesy in permitting the publication of my report.

Sodium and Potassium. The most careful investigation of sea water has been made by Dittmar, reported in the "Report of the Scientific Results of the Exploring Voyage of H. M. S. Challenger, 1873-1876," Vol. I, Physics and Chemistry. This work was not at hand when this investigation was undertaken and the usual methods for determining sodium and potassium were adopted. These are given in "Mineral Waters of the United States," Bulletin 91, Bureau of Chemistry, by J. K. Haywood and B. H. Smith. The determination of sodium came out low, the total bases being insufficient for the total acids. This experience is in agreement with the statement of Dittmar that "the routine method adopted in mineral salt analysis, i. e., the elimination of lime and magnesia and subsequent joint determination of soda and potash as sulphates or muriates, would never give sufficiently precise results." My determinations were therefore corrected by employing Dittmar's method of "total sulphates." Ten cubic centimeters of water were weighed out in a glass stoppered weighing bottle and evaporated to dryness in a platinum dish with a small excess of sulphuric acid, a dilute solution of known strength being employed. After evaporation to dryness over steam, the residue

*Reprint from The Journal of The Am. Chem. So. May, 1910.

was heated on a sand bath and finally ignited to dull redness to constant weight. The following figures show the value of this method. The values for sodium sulphate by the total sulphate method and by calculation from the determinations of the other constituents differed by two parts in a thousand. On the other hand the values obtained experimentally after elimination of sulphuric acid, lime and magnesia and by calculation from the determinations of the other constituents differed anywhere from thirteen to thirty in a thousand.

Calcium and Magnesium. Forty cubic centimeters of water were weighed out and transferred to a beaker. One cc. 5N hydrochloric acid was added and the mixture boiled to expel carbon dioxide. After cooling, four cc. 5N ammonium hydroxide and five cc. N|2 ammonium oxalate solution were added. The next day the supernatant liquid was decanted upon a filter, the residue was redissolved in dilute hydrochloric acid and precipitated with ammonium hydroxide, and a little ammonium oxalate solution. The following day the calcium oxalate was filtered upon the filter already used, washed with hot water and ignited in a platinum crucible to constant weight. The combined filtrates were concentrated to a volume of 150 cc., cooled, mixed with ten cc. normal disodium phosphate solution and ten cc. strong ammonium hydroxide. The next day the precipitate was filtered off, washed with dilute ammonium hydroxide and finally water. It was ignited in an open platinum crucible.

Chlorine. Eight cc. sea water were weighed out and transferred to a beaker. Titration was conducted with a standard solution of silver nitrate (one cc.=0.003555 g Cl), using potassium chromate as indicator. In order to better observe the change of tint, a standard of comparison was made by precipitating a sodium chloride solution with excess of silver nitrate and re-establishing the yellow color with a little more salt. The silver nitrate solution was standardized by means of two samples of sodium chloride 1. A sample labelled "Sodium Chloride c. p., Eimer and Amend" was dissolved in pure water and reprecipitated with hydrochloric acid. It was filtered off,

washed with water and ignited. 2. A sample labelled "Sodium Chloride c. p. Special. Baker's Analyzed Chemicals." The impurities being CaO=0.001%, Fe=0.0001%, SO^3=0.001%.

Sulphuric Acid. To 25 cc. sea water which had been weighed, were added while hot 2 cc. dilute hydrochloric acid and 3 cc. N barium chloride solution. The next day the barium sulphate was filtered off, washed with hot water and ignited in a platinum crucible.

Carbon dioxide. The determination of carbon dioxide was carried out by titrating 100 g. of water with 0.05 N hydrochloric acid, using phenol-phthalein as indicator for normal carbonates and then methyl orange for bicarbonates. The results were checked by titrating with 0.05 N acid potassium sulphate as recommended by Cameron.

Specific gravities. The specific gravities were determined by the use of a picnometer of U form. The temperature employed was that of the laboratory, in order to avoid the usual condensation of moisture on the picnometer if lower temperatures were used.

The waters. Five samples of water were analyzed. The localities were marked upon a chart of Beaufort Harbor, which accompanies my report to the Bureau of Fisheries. A. Taken in Beaufort Inlet. B. At the Laboratory dock where water is taken for the Laboratory aquaria. C. In Bogue Sound, opposite Morehead, where *Toxopneustes* are abundant. D. At a point between the eastern end of Beaufort and Bird Island shoal. E. At Green Rock, in Newport River, near the entrance to Core Creek.

The results are given below in four tables. Comparison is made with Dittmar's results. Challenger water No. 924, a deep sea water, is given in three tables, because this is the only water whose composition is reported in parts per thousand of water. It does not, of course, represent the average. For example, the value for chlorine is 55.396 per cent of the total salts, whereas the average for the 76 analyses is 55.420. Comparison is also made with the analysis of a water mentioned in

an article by Curt Herbst in "Archiv fur Entwickelungsmechanik der Organismen, Vol. 5, page 651. This water is from the Mediterranean Sea, below Naples, Italy.

TABLE I.

(Parts per 1,000 grams of sea water.)

	A	B	C	D	E	924	Herbst
Cl	19.909	19.635	19.767	19.810	17.571	19.201	21.137
SO_4	2.754	2.681	2.699	2.730	2.378	2.673	3.237
CO_3	0.132	0.129	0.129	0.129	0.129	0.143	*0.080
Na	11.049	10.968	11.022	11.036	9.771	10.607	11.936
K	0.442	0.390	0.394	0.394	0.368	0.380	0.409
Ca	0.433	0.429	0.440	0.436	0.392	0.483	0.473
Mg	1.353	1.301	1.313	1.332	1.177	1.301	1.362
Total	36.072	35.533	35.767	35.867	31.786	34.788	38.634

TABLE II.

(Parts per 1,000 grams of sea water.)

	A	B	C	D	E	924	Herbst
NaCl	28.043	27.836	27.977	28.006	24.796	26.882	30.292
KCl	0.842	0.742	0.751	0.751	0.702	0.725	0.779
$MgCl_2$	3.379	3.245	3.300	3.335	2.972	3.413	3.240
$MgSO_4$	2.417	2.328	2.320	2.372	2.062	1.937	2.638
$CaSO_4$	1.171	1.168	1.202	1.188	1.039	1.591	1.605
$CaCO_3$	0.220	0.214	0.214	0.215	0.215	0.240	*0.080

Total, same as above.

TABLE III.

(Percentage of total salts.)

	A	B	C	D	E	Dittmar†	Herbst
Cl	55.191	55.257	55.270	55.231	55.280	55.292	54.710
SO_4	7.635	7.546	7.547	7.612	7.481	7.692	8.380
CO_3	0.366	0.363	0.361	0.360	0.405	0.207	*0.207
Na	30.630	30.867	30.818	30.768	30.741	30.593	30.894

*The residue insoluble in water after evaporation to dryness.

†Average of analysis of Challenger waters.

K	1.226	1.098	1.102	1.099	1.157	1.106	1.059
Ca	1.201	1.208	1.230	1.216	1.233	1.197	1.224
Mg	3.751	3.661	3.672	3.714	3.703	3.725	3.526

Total, 100 per cent.

TABLE IV.

(Percenage of total salts.)

	A	B	C	D	E	924	Herbst
NaCl	77.743	78.340	78.229	78.083	78.010	77.274	78.408
KCl	2.334	2.088	2.100	2.093	2.208	2.085	2.016
$MgCl_2$	9.367	9.132	9.227	9.300	9.350	9.811	8.386
$MgSO_4$	6.700	6.551	6.487	6.612	6.487	5.569	6.828
$CaSO_4$	3.246	3.287	3.361	3.313	3.269	4.572	4.154
$CaCO_3$	0.610	0.602	0.596	0.599	0.676	0.689	*0.208

Total, 100 per cent.

Specific gravities at 28.7 degrees (corr.)

A. 1.0227; B. 1.0222; C. 1.0226; D. 1.0227; E. 1.0193.

*Insoluble residue.